

Laser scattering in large-scale-length plasmas relevant to National Ignition Facility hohlraums*

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We have used homogeneous plasmas of high density (up to $1.5 \cdot 10^{21}$ electrons per cm^3) and temperature (~ 3 keV) with large density scalelengths (~ 2 mm) in order to approximate conditions within National Ignition Facility (NIF) scale hohlraums. Using these plasmas we have studied the dependence of stimulated Raman (SRS) and Brillouin (SBS) scattering on beam smoothing and plasma conditions at the NIF relevant laser intensity (3ω at $2 \cdot 10^{15} \text{Wcm}^{-2}$). Narrowly collimated SRS has been observed from low-Z plasmas which are representative of the plasma filling most of the ignition-scale hohlraum, while SBS backscatter occurs in the high-Z plasma of gold ablated from the hohlraum wall. Both SBS and SRS are reduced by use of smoothing by spectral dispersion (SSD). We have investigated the effect of damping on the stimulated scattering processes in several experiments. (1) Electron Landau damping of SRS was modified by varying plasma temperature and density with the result that SRS reflectivity reduced as damping was increased, consistent with linear theory. (2) Ion Landau damping of the acoustic waves produced by SBS was varied by modifying the concentration of light dopant ions within the plasma. In weakly damped "high-Z" plasmas (e.g. pure CO_2 , Au or Xe) the SBS was observed to decrease as lighter ions were added (H or Be), again in accordance with linear theory. However the reduction in ion wave damping also produced an increase in SRS reflectivity, consistent with the interpretation that SRS is being limited by the Langmuir Decay Instability, which is dependent on ion wave damping. (3) Other experiments studying the interplay between SBS and SRS, when ion damping is held constant, have shown that they are anticorrelated as the density of the target is varied (altering electron Landau damping). Low density plasmas ($7\% - 9\% n_{\text{critical}}$) show SBS dominating over SRS while experiments at higher density ($10\% - 15\% n_{\text{critical}}$) show SRS dominating over SBS (by 4 orders of magnitude at the higher density). Linear theory indicates that SBS gain should be higher in the higher density plasmas, while the experiments show a dramatic reduction in SBS at high density. The results imply that SRS determined by electron Landau damping controls SBS in our large scale length plasmas, only allowing SBS to grow when SRS is too heavily damped to grow. The significance of the results of these different experiments will be discussed.

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Prefer oral session

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